

Case Report

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The Impella Device as a Temporary Bridge for Acute Mechanical Circulatory Support

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Introduction

The mortality rate from cardiogenic shock after acute myocardial infarction (MI) is high without reperfusion (70%-80%) [1]. Early revascularization is the basis of treatment of acute MI complicated by cardiogenic shock. Mechanical circulatory devices provide additional support for patients with refractory cardiogenic shock after revascularization alone has failed. These devices have been shown in the literature to improve outcomes in contrast to pharmacologic agents and/or intra-aortic balloon pump (IABP) demonstrated in the literature [2]. Short-term ventricular assist devices (VADs) can be initiated quickly and do not necessarily require a sternotomy. The Impella devices are minimally invasively placed, catheter mounted microaxial flow pumps. They are designed to directly unload the left ventricle, reduce myocardial workload and oxygen consumption while increasing cardiac output, coronary and end-organ perfusion. The purpose of our study is to review a patient who presented with acute cardiogenic shock and was treated with an Impella 5.0 device for temporary mechanical support.

Case Report

The patient is a 60 year-old male who presented to the emergency room complaining of chest pain. He was noted to have ST segment elevation MI (STEMI). The patient was taken to the cardiac catheterization lab and was found to have total occlusion of his left anterior descending artery. The artery was opened and a stent was placed but unfortunately, the stent acutely closed and the patient went into acute cardiogenic shock. He was transferred to our institution and taken directly to the operating room. An intraoperative transesophageal echocardiogram (TEE) showed evidence of a poor cardiac function with an ejection fraction of 15% (Figure 1). His systolic blood pressure was 80/40 on inotropic support including epinephrine as well vasoconstrictors, levophed and vasopressin. In the operating room he underwent a mini-sternotomy for an emergent placement of an Impella 5.0 device

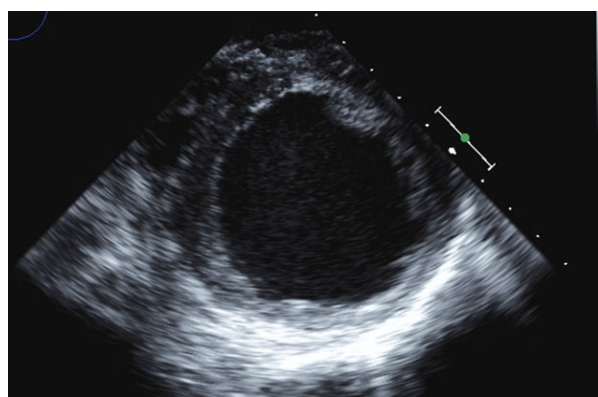


Figure 1: Intraoperative TEE shows dilated left ventricle with ejection fraction of 15%.

(Figure 2). The device was placed under TEE guidance (Figure 3) and the patient became hemodynamically stable with flow rates of 4.0 to 4.4 L/min. The patient's cardiac index with the Impella device was 2.5 to 2.8 L/min.

The initial goal was to have the patient recover cardiac function while resting his heart. Unfortunately, over the next week the patient's heart function did not improve and a more long-term mechanical assist device was required. He went back to the operating room and had a left ventricular assist device placed, the Heartmate II. He was later discharged to home and subsequently listed for heart transplantation. After 9 months the patient underwent an orthotopic heart transplant. The patient recovered well from surgery and has been seen multiple times in clinic.

Impella System

At the present time the approved Impella technology comprises the Impella 2.5 and 5.0/LD devices (Abiomed Inc, Danvers MA) both devices have been described elsewhere [3,4]. Briefly, the Impella 2.5

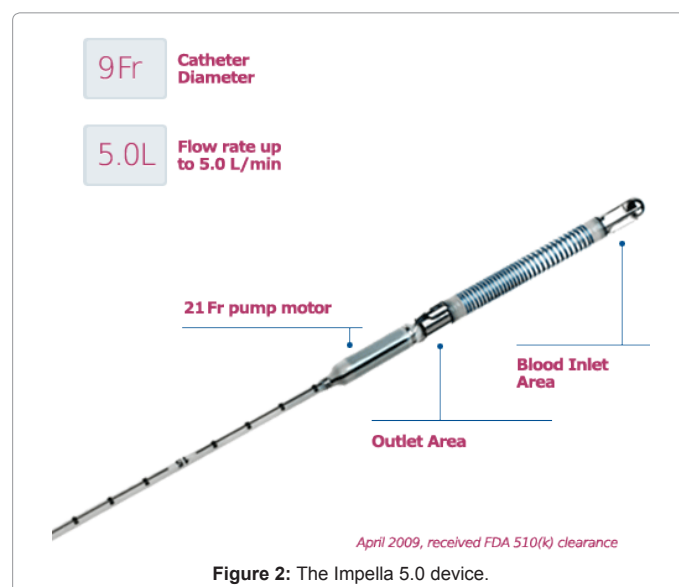


Figure 2: The Impella 5.0 device.

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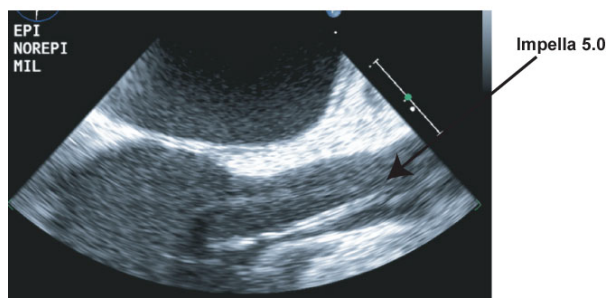


Figure 3: An intraoperative TEE shows the Impella 5.0 within the aortic root entering the left ventricle.

is a 12Fr microaxial pump mounted on a 9Fr catheter shaft housing the motor driveline and the purge line system. It is inserted through the femoral artery and positioned across the aortic valve into the left ventricle under fluoroscopic guidance. The Impella 5.0/LD device is also mounted on the same 9Fr catheter shaft and the pump itself is 21Fr in diameter. It is inserted via trans-thoracic or trans-sternal access through a 10 mm vascular graft sewn end to side on the ascending aorta and advanced across the aortic valve in the left ventricle (LV). Alternatively, it could also be inserted peripherally via the femoral artery and advanced retrograde with transesophageal echocardiography guidance across the aortic valve into the LV. A peripheral insertion via the right axillary artery through a vascular graft is also possible. The Impella 2.5 and 5.0/LD devices are capable of generating up to 2.5 L/min and 5.0 L/min of forward flow in the systemic circulation, respectively. Both Impella pumps are powered and controlled by the same Impella console; it allows management of the pump speed (by 9 gradations) and displays the pressure difference between the inflow and outflow outlets.

An Activated Clotting Time (ACT) between 250 and 500 seconds is required during Impella pump insertion intraoperatively. After the pump is inserted and positioned the pump requires an ACT between 160 and 180 seconds preventing clot formation in the motor. A continuous intravenous infusion of heparin is recommended on postoperative day#1 to achieve a Partial Thromboplastin Time between 40 and 50 seconds when the chest tube drainage decreases to less than 50 mL/hr.

Discussion

This case report demonstrates the value of the Impella device in a patient with acute cardiogenic shock. The 60 year-old patient was treated expeditiously with the Impella 5.0 device through a mini-sternotomy incision. The device was placed through a mini-sternotomy as the exposure was more than adequate for the ascending aorta. The patient was not placed on cardiopulmonary bypass for the procedure. The advantage of the Impella device is that it can be placed through a small incision and does not require a sternotomy. The device can also be placed through the axillary or femoral approach. The Impella 5.0 device was chosen instead of the Impella 2.5 because of the greater level of support that was needed given the low ejection fraction of 15% and his poor clinical state.

Traditionally, a significant reduction of the mortality rate for patients with cardiogenic shock has not been observed despite early revascularization, advances in medical therapy, and mechanical hemodynamic support technology. The patient in this case report presented in acute cardiogenic shock and he was saved after the emergent placement of the Impella device. These devices are temporary and as a result he was transitioned to a longer term device, the Heartmate II prior to eventually getting a heart transplant. This case fully demonstrates the utility of the Impella device by functioning as a bridge to decision making. If the patient had recovered cardiac function, the Impella device could have been removed, however since he did not regain function he was transitioned to the Heartmate II.

In the setting of severe LV dysfunction, the Impella provides decompression of the LV necessary to reduce wall stress and increases the likelihood of myocardial recovery. The circulatory support provided by the Impella device is only a portion of the benefit as the ability to unload the LV is very significant [5]. The benefit of this Impella system is being more commonly recognized for its survival benefit in patients in acute cardiogenic shock [6]. Taken together, the patient's clinical course demonstrates the utility of the Impella device. It provides a key role in allowing for support and decision making for patients who present in extreme clinical conditions.

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